



## INTELLEC PROMPT 48 MCS-48 MICROCOMPUTER DESIGN AID

Complete low cost design aid and EPROM programmer for revolutionary MCS-48 single component computers

Simplifies microcomputing, allowing user to enter, run, debug, and save machine language programs with calculator-like ease

Utilizes two removable 8-bit MCS-48 CPUs

- 8748 CPU with erasable, reprogrammable on-chip program memory
- 8035 CPU with off-chip program memory

1K-byte erasable, reprogrammable on-chip (8748), expandable program memory, 1K-byte RAM in PROMPT system

64 bytes RAM on-chip, expandable register memory

256 bytes expandable RAM data memory in PROMPT system

27 on-chip TTL compatible expandable I/O lines

On-chip clock, internal timer/event counter, two vectored interrupts, eight level stack control

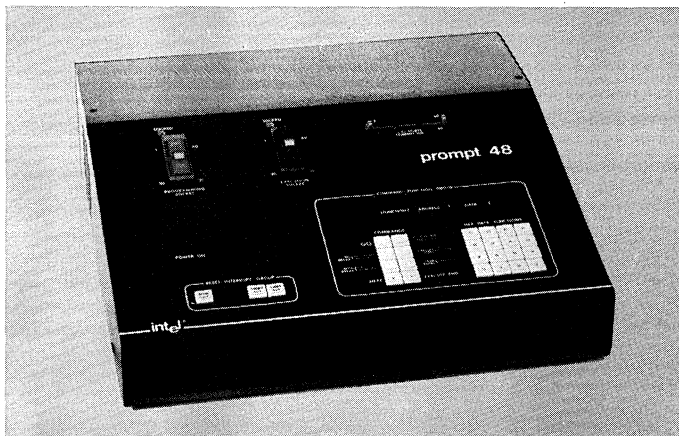
Single +5V DC system power requirement

Integral keyboard and displays (no teletypewriter or CRT terminal required)

Extensive PROMPT 48 monitor, allowing system I/O, bus, and memory expansion

Includes comprehensive design library

The Intellec Prompt 48 MCS-48 Microcomputer Design Aid is a low cost, fully-assembled design aid for the revolutionary 8748 single component microcomputer. PROMPT 48 simplifies the programming of MCS-48 systems — programs may be entered and debugged with calculator-like ease on the large, informative display and keyboard panel. The comprehensive design library with tutorial manual is ideal for newcomers to microcomputing. PROMPT 48's panel connector allows easy access to I/O ports and system bus. Thus users can expand program memory beyond the 1K bytes provided internally.



## FEATURES

### Single Component Computer

The 8748 is the first microcomputer fully integrated on one component. All elements of a computing system are provided, including CPU, RAM, I/O, timer, interrupts, and erasable, reprogrammable nonvolatile program memory.

### Programming Socket

PROMPT's programming socket programs this revolutionary "smart PROM"—the 8748—in a highly reliable, convenient manner. A fail-safe interlock ensures the device is properly inserted before applying programming pulses. Each location may be individually programmed, one byte at a time. A read-before-write programming algorithm prevents device damage by inadvertently programming unerased memory.

### MCS-48 Processors

The execution socket accepts either an 8035 or an 8748 MCS-48 processor. Both are supplied with each PROMPT 48, and either can serve as heart of the PROMPT system. There are no processors within the PROMPT 48 mainframe, which instead contains monitor ROM and RAM, user RAM, peripherals, drivers, and sophisticated control circuitry. Once a processor is seated in the execution socket and power is applied, the PROMPT system comes to life. Various access modes may be selected such as program execution from PROMPT system RAM, or from on-chip PROM. Thus programs may first be executed from PROMPT RAM with the 8035 processor. When debugging is complete, the 8035 (execution socket) processor can program the 8748 (programming socket) processor. Finally, a programmed 8748 processor may be exercised by itself from the execution socket. The execution socket processor runs either monitor or user programs.

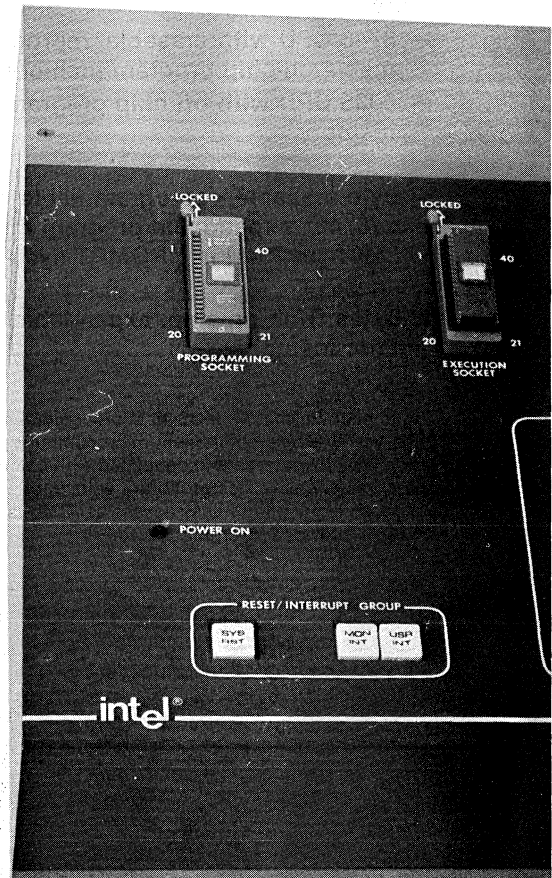
### System Monitor

The system reset command initializes the PROMPT system and enters the monitor. The monitor interrupt command exits a user program gracefully, preserving system status and entering the monitor. The user interrupt command causes an interrupt only if the PROMPT system is running a user program. A comprehensive system monitor resides in four 1K-byte read only memories. It drives the PROMPT keyboard and displays and responds to commands and functions. The top 16 bytes of on-chip program memory must be used by the PROMPT system to switch between monitor and user programs. It requires one level of the MCS-48 eight-level stack.

### Commands

PROMPT 48's commands are grouped and color-coded to simplify access to the 8748's separate program and data memory. Registers, data memory, or program memory, may be examined and modified with the examine and modify commands. Then either the next or previous register and memory locations may be accessed with one keystroke. Programs may be exercised in three modes. The go no break (GO NO BREAK) runs in real time. The go with break (GO WITH BREAK) mode is not

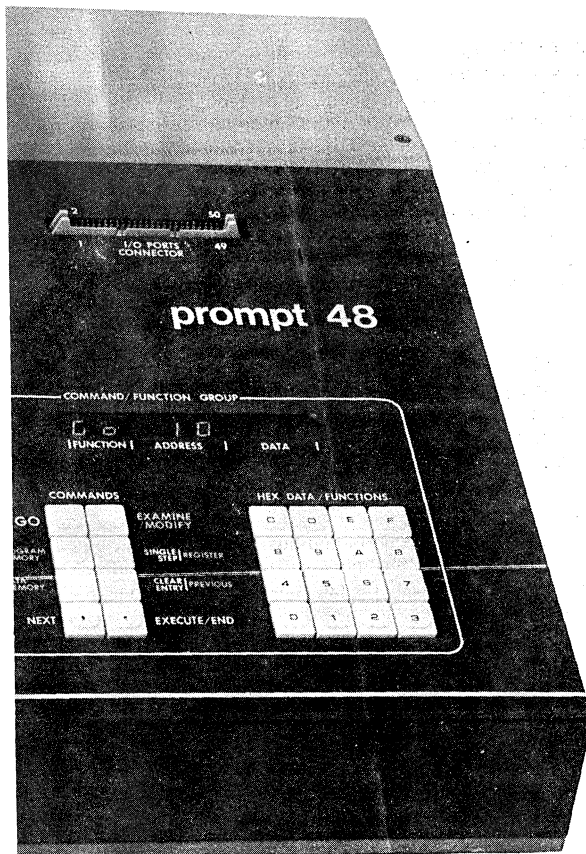
real time — after each instruction the MCS-48 program counter is compared against pending breakpoints. If no break is encountered, execution resumes. The go single step (GO SINGLE STEP) mode exercises one instruction at a time. Commands are like sentences, with parameters separated by  $\square$  NEXT. Each command ends with  $\square$  EXECUTE/END. In addition to the PROMPT basic commands, thirteen functions simplify programming. Each is started merely by pressing a hex data/function key and entering parameters as required, as shown in Table 1.



# INTELLEC PROMPT 48

## Cable Interface

An optional cable, PROMPT-SER, directly connects the PROMPT system to virtually any terminal via a rear access slot.



| Key | Function                         | Operation  |
|-----|----------------------------------|--|
| [2] | Port 2 map                       | Allows specification of direction of each pin on port 2. Port 2 is multiplexed to address external program memory and expand I/O. Thus it must be buffered; the P2 map command establishes the direction of buffering. |
| [3] | Program EPROM                    | Programs 8748 EPROMs.  |
| [4] | Byte search (with optional mask) | Sweeps through register, data, or program memory searching for byte matches. Starting and ending memory addresses are specified.   |
| [5] | Word search (with optional mask) | Sweeps through register, data, or program memory searching for word matches. Starting and ending memory addresses are specified.   |
| [6] | Hex calculator                   | Computes hexadecimal sums and differences.   |
| [7] | 8748 program for debug           | Similar to program EPROM, but ensures that the top of program memory contains monitor re-entry code for debugging.   |
| [8] | Compare                          | Verifies any portions of EPROM program memory against PROMPT memory.   |
| [9] | Move memory                      | Allows blocks of register, data, or program memory to be moved.  |
| [A] | Access                           | Specifies one of six access modes for PROMPT 48. For example EPROM, PROMPT RAM, or external program memory, and a variety of input/output options may be selected.   |
| [B] | Breakpoint                       | Allows any or all of the eight breakpoints to be set and cleared.  |
| [C] | Clear                            | Clears portions of register, data, or program memory.  |
| [D] | Dump                             | Dumps register, data, or program memory to PROMPT's serial channel: for example, a teletypewriter paper tape punch.  |
| [E] | Enter                            | Enters (reads) register, data, or program memory from PROMPT's serial channel.   |
| [F] | Fetch                            | Fetches programs from EPROM to PROMPT RAM.   |

Table 1. PROMPT 48 Commands and Functions

## Access

Easy access to the pins of the executing processor is provided via the I/O ports and bus connector. Only the EA external access, SS single step, and X1, X2 clock inputs are reserved for the PROMPT system.

## Expansion

Program or data memory may be expanded beyond that provided on-chip or in the PROMPT system. I/O ports may be expanded, as with the 8243, or peripheral controllers may be memory-mapped. The I/O ports and Bus connector allows the execution socket processor to be directly interfaced to prototype systems, yet be controlled from the PROMPT panel.

## Control

The command/function group panel keyboard and displays completely control PROMPT 48—a teletypewriter or CRT terminal is not needed. A hyphen prompting character appears whenever a command or function can be entered. Addresses and data are shown whenever examining registers and memory. Parameters for commands and functions are also shown.

## FUNCTIONAL DESCRIPTION

"PROMPT" stands for PROgraMMing Tool. It is a programmer for 8748 EPROMs, and a versatile aid for debugging MCS-48 programs. Programs can be entered via its integral panel keyboard, programming socket, or serial channel. Almost any terminal can be interfaced to the serial channel, including a teletypewriter, CRT, or an Intellec microcomputer development system. Intellec PROMPT 48 simplifies the programming of MCS-48 systems. Like the 8748 it is radically new, highly integrated, and expandable. Like the MCS-48 family, it is low cost, and ideal for small applications and programs. It is a design aid, not a development system with sophisticated software and peripherals.

## MCS-48 Processors

PROMPT 48 comes complete with two of Intel's revolutionary MCS-48 processors: an 8748-4 Single Component 8-Bit Microcomputer and an 8035-4 Single Component 8-Bit Microcomputer. Advances in n-channel MOS technology allow Intel, for the first time to integrate into one 40-pin component all computer functions:

- 8-bit CPU
- 1K x 8-bit EPROM/ROM program memory
- 64 x 8-bit RAM data memory
- 27 input/output lines
- 8-bit timer/event counter

**Performance** — More than 90 instructions — each one or two cycles — make the single chip MCS-48 equal in performance to most multi-chip microprocessors. The MCS-48 is an efficient controller and arithmetic processor, with extensive bit handling, binary, and BCD arithmetic instructions. These are encoded for minimum program length; 70% are single byte operation codes, and none is more than two bytes.

**Flexibility** — Three interchangeable, pin-compatible devices offer flexibility and low cost in development and production, as follows:

**8748** — with user-programmable and erasable EPROM program memory for prototype and pre-productions systems.

**8048** — with factory-programmed mask ROM memory for low-cost, high volume production.

**8035** — without program memory, for use with external program memories.

**Circuitry** — Each MCS-48 processor operates on a single +5V supply, with internal oscillator and clock driver, and circuitry for interrupts and resets. Extra circuitry is in the 8048 ROM processor to allow low power standby operation. The 64 x 8 RAM data memory can be independently powered.

**Compatibility** — For systems requiring additional compatibility, the MCS-48 can be expanded with the new 8243 I/O expander, 8155 I/O and 256-byte RAM, 8755 I/O and 2K-byte EPROM, or 8355 I/O and 2K ROM devices. MCS-48 processors readily interface to MCS-80/85 peripherals and standard memories.

## Memory Capacity

PROMPT 48 is a complete, fully assembled and powered microcomputer system including program memory, data memory, I/O, and system monitor beyond that available on MCS-48 single component computers. 1K bytes of PROMPT system RAM serve as "writable program memory" — a ROM simulator for the program memory on each MCS-48 computer. 256 bytes of PROMPT system RAM serve as "external data memory," beyond the 64 register bytes on each MCS-48 computer. Users may further expand program or data memory via the panel I/O ports and bus connector.

## Programming

Programs written first in assembly language, are entered in machine language and debugged with calculator-like ease on the large, informative display and keyboard panel. Most MCS-48 operations can be specified with only two keystrokes. Once entered, routines can be exercised one instruction (single step) or many instructions at a time. The principal MCS-48 register — the accumulator — is displayed while single stepping. Programs can be executed in real time (GO NO BREAK) or with as many as eight different breakpoints (GO WITH BREAK).

## Control

PROMPT 48 can be fully controlled either by the panel keyboard and displays, or remotely by a serial channel. Thus a teletypewriter or CRT can be used but neither is required.

## Access

The PROMPT panel I/O ports and bus connector allow easy access to all MCS-48 pins except those reserved for control by the PROMPT system, namely EA external access, SS single step, and X1, X2 clock inputs.

## Optional Expansion

PROMPT 48 may be expanded beyond the resources on both the MCS-48 single component computer and the PROMPT system. External program and data memory may be interfaced and input/output ports added with the 8243 I/O expander.

# INTELLEC PROMPT 48

## Documentation

The PROMPT 48 manual includes chapters for the reader with little or no programming experience. Topics treated range from number systems to microcomputer hardware design. A novel, unifying set of tutorial diagrams — MICROMAPS — simplify microcomputer

concepts. PROMPT's handy, pocket-sized reference cardlet can be affixed to the mainframe. Programming pads aid in the organization and documentation of programs. These features, plus a comprehensive design library of manuals, articles, and application notes, make the Intellec PROMPT 48 ideal for the newcomer to microcomputing.

## SPECIFICATIONS

### Timing

**Basic Instruction** —  $2.5 \mu\text{s}$

**Cycle Time** —  $t_{\text{CY}} = 2.5 \mu\text{s}$

**Clock** —  $6 \text{ MHz} \pm 0.1\%$

### Memory Bytes

The 8748 contains 64 bytes of register memory, no external data memory, and 1024 bytes of RAM program memory. The PROMPT system provides 256 bytes of external data memory, and 1024 bytes of RAM program memory. PROMPT RAM program memory can be used in place of the on-chip EPROM program memory; thus programs less than 1024 bytes may be designed. For larger programs additional memory can be directly interfaced to the MCS-48 bus via the PROMPT panel I/O ports and bus connector.

### Memory Configuration

| Memory   | Maximum | On Chip    | In PROMPT 48 |
|----------|---------|------------|--------------|
| Register | 64      | 64         | 0            |
| Data     | 3328    | 0          | 256          |
| Program  | 4096    | 1024 EPROM | 1024 RAM     |

### I/O Ports

All MCS-48 I/O ports are accessible on the PROMPT panel connector.

**Bus** — A true bidirectional 8-bit port with associated strobes. If the bidirectional feature is not needed, bus can serve as either a statically latched output port or a non-latching input port. Input and output lines cannot be mixed.

**Ports 1 and 2** — Data written to these 8-bit ports is latched and remains unchanged until written. As inputs these lines are not latching. The lines of ports 1 and 2 are called quasibidirectional. A special output structure allows each line of port 1 and half of port 2 to serve as an input, an output, or both. Any mix of input, output, and both lines is allowed.

**T0, T1, and INT** — Three pins that can serve as inputs. T0 can be designated as a clock output. Input/output can be expanded via the PROMPT panel connector with a special I/O expander (8243) or standard peripherals.

### Reset and Interrupts

**Reset** — initializes the PROMPT system and enters the monitor.

**Monitor Interrupt** — exits a user program gracefully, preserving system status and entering the monitor.

**User Interrupt** — causes an interrupt only if the PROMPT system is running a user program.

The processor traps to location  $3_{16}$ . The MCS-48 timer/event counter is not used by the PROMPT system and is available to the user. Either timer flag or interrupt will signal when overflow has occurred. The timer interrupt can be used only in the go-no-break (real time) mode.

### EPROM Programming

PROMPT 48 provides a programming socket to directly program 8748s. Programs are loaded into the PROMPT RAM program memory via keyboard, EPROM, teletypewriter, or other serial interface. A fail-safe interlock ensures programming pulses are applied only if the device is properly inserted. Inadvertant reprogramming is prevented by a read-before-write programming algorithm. Each location may be individually programmed, one byte at a time.

### Panel I/O Ports and Bus Connectors

All MCS-48 pins, except five, are accessible on the I/O ports and bus connector. The five reserved for PROMPT system control are EA external access, SS single step, X1, X2 crystal inputs, and 5V. Due to internal buffering of the MCS-48 bus, access times will be negligibly degraded by the PROMPT system. Since MCS-48 processors do not communicate internal address gate status, bus data must be driven out if neither PSEN nor RD is asserted.

### System Devices

Both user programs and the PROMPT monitor enjoy access to system devices: serial I/O, panel displays, and keyboard. These are memory-mapped to program memory addresses beyond 2K.

**Serial I/O** — The serial I/O port (data  $820_{16}$ , control  $821_{16}$ ) is defined by software and jumpers for 110 baud, 20 mA current loop, but can easily be jumpered for other baud rates and RS232C levels. Asynchronous or synchronous transmission, data format, control characters, and parity can be programmed.

**Panel Displays** — Eight display ports (data  $810_{16}$ - $817_{16}$ ) allow each of the panel displays to be written from user programs. Data written on a display device will time out after a fixed interval. Displays must be refreshed on a polled or interrupt-driven basis. User programs can call software drivers which provide this capability.

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**Keyboard** — Software is used to debounce the panel keyboard (data 810<sub>16</sub>). The monitor's input routines (see Software Drivers) provide this debouncing and can be called from user programs.

### Commands

Single step }  
With break } Go  
No break }

Examine/modify { Register } Memory  
                          { Data }  
                          { Program }

Open previous/clear/entry   ☐ Next   ☐ Execute/End

### Functions

- [2] Port 2 map
- [3] Program EPROM (8748)
- [4] Search (R, D or P)\* memory for 1 byte, optional mask
- [5] Search (R, D or P) memory for 2 bytes, optional mask
- [6] Hexadecimal calculator +, -
- [7] 8748 program EPROM for debug
- [8] Compare EPROM with memory
- [9] Move memory (R, D or P)
- [A] Access
- [B] Breakpoint
- [C] Clear memory (R, D or P)
- [D] Dump memory (R, D or P)
- [E] Enter (read) memory (R, D or P)
- [F] Fetch EPROM program memory

#### Note

\*R, D, or P is register, data, or program.

### Software Drivers

**Panel Keyboard In** — KBIN, KDBIN

**Panel Display Out** — DGS6, DGOUT, HXOUT, BLK, REFS, ENREF

**Serial Channel** — CI, CO, RI, PO, CSTS

### Connectors

**Serial I/O** — 3M 3462-0001 Flat Crimp/AMP 88106-1 Flat Crimp/ TI H312113 Solder/AMP 1-583485-5 Solder.

**Panel I/O Ports and Bus Connector** — 3M 3425 Flat Crimp. A complete cable set including wirewrap header for prototyping is included with each PROMPT.

### Equipment Supplied

PROMPT 48 mainframe with two MCS-48 processors (8748, 8035), display/keyboard, EPROM programmer, power supply, cabinet, and ROM-based monitor.

110 V AC power cable

110 or 220 V AC

Fuse

Panel I/O ports

Bus connector cable set

### Physical Characteristics

**Height** — 5.3 in. (13.5 cm) max

**Width** — 17 in. (43.2 cm)

**Depth** — 17 in. (43.2 cm) max

**Weight** — 21 lb. (9.6 kg)

### Electrical Characteristics

**Power Requirements** — either 115 or 230V AC ( $\pm 10\%$ ) may be switch selected on the mainframe. 1.8 amps max current (at 125 V AC).

**Frequency** — 47-63 Hz

### Environmental Characteristics

**Operating Temperature** — 0°C to +40°C

**Non-Operating Temperature** — 20°C to +65°C

### Reference Manuals

**9800402** — Intellec PROMPT 48 User's Manual (SUPPLIED)

**9800270** — MCS-48 User's Manual (SUPPLIED)

**9800255** — MCS-48 and UPI-41 Assembly Language Programming Manual (SUPPLIED)

Reference manuals are shipped with each product only if designated SUPPLIED (see above). Manuals may be ordered from any Intel sales representative, distributor office or from Intel Literature Department, 3065 Bowers Avenue, Santa Clara, California 95051.

## ORDERING INFORMATION

### Part Number    Description

PROMPT-48 or  
PROMPT-48-220V    Intellec PROMPT 48 MCS-48 micro-computer design aid. Complete with two MCS-48 processors (8748 and 8305), EPROM programmer, integral keyboard, displays, and system monitor in ROM.

PROMPT-SER    Serial cable for connecting PROMPT to TTY, CRT